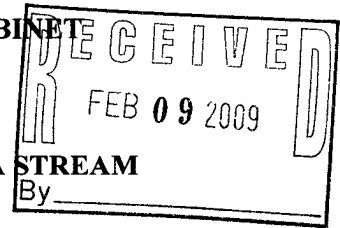


AI 103335

**COMMONWEALTH OF KENTUCKY
NATURAL RESOURCES & ENVIRONMENTAL PROTECTION CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER**



**APPLICATION FOR PERMIT TO CONSTRUCT ACROSS OR ALONG A STREAM
AND / OR WATER QUALITY CERTIFICATION**

Chapter 151 of the Kentucky Revised Statutes requires approval from the Division of Water prior to any construction or other activity in or along a stream that could in any way obstruct flood flows or adversely impact water quality. *If the project involves work in a stream, such as bank stabilization, dredging or relocation, you will also need to obtain a 401 Water Quality Certification (WQC) from the Division of Water.* This completed form will be forwarded to the Water Quality Branch for WQC processing. The project may not start until all necessary approvals are received from the KDOW. For questions concerning the WQC process, contact the WQC section at 502/564-3410.

If the project will disturb more than 1 acre of soil, you will also need to complete the attached Notice of Intent for Storm Water Discharges, and return both forms to the Floodplain management Section of the KDOW. This general permit will require you to create and implement an erosion control plan for the project.

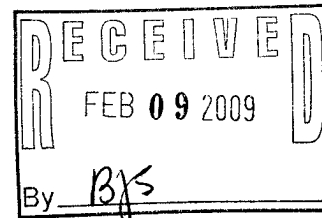
1. **OWNER:** Boone County Fiscal Court
Give name of person(s), company, governmental unit, or other owner of proposed project.
MAILING ADDRESS: 2950 Washington Street, Burlington, KY 41005

TELEPHONE #: (859) 572-7588 **EMAIL:** fennells@nku.edu
2. **AGENT:** Northern Kentucky University Center for Applied Ecology (see "Remarks" in Item 18 below)
Give name of person(s) submitting application, if other than owner.
ADDRESS: 510 Johns Hill Road, Highland Heights, KY 41076

TELEPHONE #: (859) 572-7588 **EMAIL:** fennells@nku.edu
3. **ENGINEER:** Scott Fennell, PE **P.E. NUMBER:** 18761
Contact Division of Water if waiver can be granted.
TELEPHONE #: (859) 572-7588 **EMAIL:** fennells@nku.edu
4. **DESCRIPTION OF CONSTRUCTION:** The project includes the restoration and enhancement of 4000 feet of
Describe the type and purpose of construction and describe stream impact
perennial, intermittent, and ephemeral tributaries of Allen Fork. Boone Woods Park is owned and operated by Boone
County. The property is a 50-acre park with picnic areas, playgrounds and a variety of sports facilities for disc golf, tennis,
soccer, volleyball, and basketball. The streams that flow through the park are impacted by past and present land use. Stream
restoration will include sloping the banks, restoring sinuosity, and stabilizing banks and channel bed with rock deflectors and
a vane. A 12.5-acre riparian buffer will be established. Invasive plants species will be controlled and native species restored
within the buffer. See attached Stream Restoration Plan for details.
5. **COUNTY:** Boone **NEAREST COMMUNITY:** Burlington, Kentucky
6. **USGS QUAD NAME:** Burlington Quad **LATITUDE/LONGITUDE:** 39°1'37"N, 84°42'29"W (NAD83)
7. **STREAM NAME:** Unnamed tributaries of Allen Fork **WATERSHED SIZE (in acres):** 690 acres
8. **LINEAR FEET OF STREAM IMPACTED:** 1968 feet perennial tributaries of Allen Fork, 2142 feet of intermittent
tributaries of Allen Fork, and 172 feet of ephemeral tributaries of Allen Fork
9. **DIRECTIONS TO SITE:** From I-71/I-75: Take Exit 181, KY 18 West; Turn right onto Veterans Way; The project is
located at Boone Woods Park just past the R.C. Durr YMCA.
10. **IS ANY PORTION OF THE REQUESTED PROJECT NOW COMPLETE?** Yes ☒ No ☐ If yes, identify the
completed portion on the drawings you submit and indicate the date activity was completed. DATE: _____
11. **ESTIMATED BEGIN CONSTRUCTION DATE:** Summer 2009

ck pd
Nku #314158

COMMONWEALTH OF KENTUCKY
ENERGY AND ENVIRONMENT CABINET
DEPARTMENT FOR ENVIRONMENTAL PROTECTION
DIVISION OF WATER



**INDIVIDUAL KENTUCKY WATER QUALITY CERTIFICATION
FEE PAYMENT**

401 KAR 9:020 Section 401 Water Quality Certification Fees and Certification Timetable

KRS 224.16-050 authorizes the cabinet to certify pursuant to 33 U.S.C. 1341 that applicants for a federal permit regarding the construction or operation of facilities, which may result in a discharge of dredged or fill material into the waters of the Commonwealth, as defined in KRS 224.01-010(33), shall comply with the applicable provisions of the Federal Water Pollution Control Act, 33 U.S.C. 1251 et seq. KRS 224.10-100 authorizes the cabinet to establish a fee for the cost of processing applications for permits authorized under KRS Chapter 224. The project may not start until all necessary fees are paid and approvals are received from KDOW. For questions concerning the WQC process, contact the WQC Section at 502-564-3410. For more information: [HTTP://WWW.WATER.KY.GOV/PERMITTING/WQCERT/](http://www.water.ky.gov/permitting/wqcert/)

1. **OWNER:** Boone County Fiscal Court
Provide name of person(s), company, governmental unit or other owner of proposed project.
- MAILING ADDRESS:** 2950 Washington Street
Burlington, Kentucky 41005
- TELEPHONE #:** (859) 334-2245 **E-MAIL:** jearylwine@BooneCountyKy.org
- AGENCY INTEREST (AI) # OF PROJECT:** _____ (assigned by KDOW)
2. **AGENT:** Scott Fennell, PE NKU Center for Applied Ecology
Provide name of person(s) submitting application, if other than owner.
- ADDRESS:** 510 Johns Hill Road
Highland Heights, KY 41076
- TELEPHONE #:** (859) 572-7595 **E-MAIL:** fennells@nku.edu

3. **BRIEF DESCRIPTION OF CONSTRUCTION:** Under the in-lieu fee mitigation program, the Center for Applied Ecology proposes to conduct stream restoration at the Boone Woods Park in Boone County. The park is owned by Boone County and is located on Veterans Way near KY Highway 18. Three tributaries of Allen Fork run through the park and join just as they leave the property. Two of these streams (North Branch, Central Branch) are perennial and total 1968 linear feet. The other stream (South Branch) is intermittent and is 1050 linear feet. A second intermittent stream is a tributary to the Central Branch and is 1092 linear feet. There are also two ephemeral streams on the property totaling 171 linear feet. The streams feed the North Branch and the Central Branch. For a detailed description of the proposed restoration and enhancement, please refer to the attached Stream Restoration Plan.

4. **COUNTY:** Boone **NEAREST COMMUNITY:** Burlington, KY

5. **STREAM NAME(S):** Unnamed Tributaries of Allen Fork **LATITUDE/LONGITUDE:** _____
(Start and end points of each individual impact; add more sheets if necessary.)

Stream sections	Start Point Latitude/Longitude	End Point Latitude/Longitude
North Branch	84°42' 33.74" W /39° 1' 46.5" N	84°42' 35.25" W /39° 1' 38.8" N
Central Branch	84°42' 22.75" W /39° 1' 34.22" N	84°42' 35.37" W /39° 1' 38.29" N
South Branch	84°42' 34.31" W /39° 1' 27.62" N	84°42' 35.47" W /39° 1' 36.04" N

7. **TOTAL LINEAR FEET OF STREAM IMPACTED:** 4,000 **WETLAND ACRES IMPACTED:** 0

8. **EXEMPTED FROM FEE BECAUSE:**

(A) {Personal Residence: _____} (B) Agricultural Operation: _____

9. **FEES:**

Stream impact greater than 500 linear feet and less than 1,000 linear feet: Fee - \$1,000.00 _____
Stream impact 1,000 linear feet to 5,000 linear feet: Fee - \$2,500.00 X _____
Stream impact greater than 5,000 linear feet: Fee - \$5,000.00 _____
Wetland impacts: Fee \$500.00 per acre not to exceed \$5,000.00 _____
Total Fee Paid: _____

To the best of my knowledge, all the information provided is true and correct.

SIGNATURE: Jeffrey S. Earlywine **DATE:** JANUARY 20, 2009
Owner or Agent sign here. (If signed by Agent, attach Power of Attorney.)

JEFFREY S. EARLYWINE
COUNTY ADMINISTRATION

Make check to: KY STATE TREASURER

MAIL TO:

Kentucky Division of Water
Water Quality Certification Section
200 Fair Oaks Lane
Frankfort, KY 40601

Stream Restoration Plan

Boone Woods Park
Boone County, Kentucky

November 2008

BACKGROUND

Stream and riparian buffer restoration and preservation is being conducted at Boone Woods Park as compensation for unavoidable stream impacts by other parties and at other sites as required by Section 404 and/or Section 401 permits issued to the other parties. Restoration is being funded by the Northern Kentucky Stream and Wetland Restoration Fund, under the direction of the Inter-agency Review Team (IRT). The IRT is chaired by the Louisville District Corps of Engineers and includes Kentucky Division of Water, Kentucky Department of Fish & Wildlife Resources (KDFWR), US Fish and Wildlife Service, and US Environmental Protection Agency. The restoration is being conducted by the Center for Applied Ecology at Northern Kentucky University (CAE).

This Plan is being submitted by the CAE in order to obtain final project and funding approval from the IRT, and to support permit applications (Section 401 and 404, grading permits, etc). The format and information provided is generally as stipulated in the Compensatory Mitigation Rule (33 CFR 332.4(c))

ENGINEER'S CERTIFICATION

Electronic or photocopy versions of this document without a licensed professional engineer's original or electronic stamp, date, and signature affixed, are required to have the following notice: "This shall not be considered a certified document." Paper versions of this document are considered certified if the engineer's original stamp, date, and signature are affixed.



CENTER FOR APPLIED ECOLOGY

OBJECTIVES OF RESTORATION

The objectives of this project are to restore and protect streams, floodplains, and riparian buffers at the project site which provide the following functions and values:

1. Aquatic and wildlife habitat - stream shading and organic debris inputs; reproduction and refuge; substrate, cover, food production; etc.
2. Water quality protection - nutrient, pathogen, and sediment removal; floodwater management; aeration; groundwater and baseflow recharge; etc.
3. Nature viewing, passive recreation, and education opportunities in a publicly accessible natural area.

Specific restoration tasks are designed to be self-sustaining and include natural stream channel restoration; bank stabilization; removal of stream and floodplain obstructions; stormwater wetland creation; and riparian forest and meadow enhancement and restoration.

SITE SELECTION

This project provides mitigation for prior stream losses within the Middle Ohio HUC 8 Watershed, restoring and protecting values and functions of headwater streams. Additionally, the project site was identified as the highest priority restoration site in a watershed plan prepared by Bio-Habitats, Inc. (et. al.) for Boone County government (Allen Fork Headwater Feasibility Study, 2005). Allen Fork is a 303(d) Listed Impaired Water based upon sediment/siltation and nutrient pollution.

SITE PROTECTION INSTRUMENT

Boone County executed a memorandum of agreement (18 December 2007) to file a conservation easement permanently protecting the streams and riparian buffers upon approval of this plan. The conservation easement holder will be the Northern Kentucky University Research Foundation.

BASELINE INFORMATION

Site Address: Boone Woods Park, 6000 Veterans Way, Burlington, Kentucky

Lat / Long: 39.0133°N, 84.4236°W (NAD27)

Maps (Appendix A):

- Figure 1 – Location and Directions
- Figure 2 – USGS 7.5-Minute Topo Map with Watersheds
- Figure 3 – Aerial Photo

- Figure 4 – NRCS Soils Map
- Figure 5 – Project Task Locations
- Figure 6 – North Branch Stream Restoration (Task 1)
- Figure 7 – Conservation Area Restoration and Preservation (Task 4)

Site Landuse: Boone Woods Park is owned and operated by Boone County. The property is a 50-acre park with picnic areas, playgrounds and a variety of sports facilities for disc golf, tennis, soccer, volleyball, and basketball. An aerial photograph of the property is provided in Figure 3, Appendix A. The property is approximately 30 percent forested.

Streams: The streams to be enhanced or restored include approximately 4000 feet of perennial and intermittent tributaries of Allen Fork (Figure 5, Appendix A), as well as mapped and unmapped ephemeral tributaries within the conservation area.

Watershed Landuse: The 690-acre watershed that drains to the project reach is primarily residential and commercial development, roads, recreation land, and undeveloped land.

Wetlands: No jurisdictional wetlands are within the project boundaries.

Riparian Buffer: The total area of protected streams and riparian buffer is 12.5 acres. The average riparian buffer width is about 50 feet, which is to be restored to native vegetation.

Water Quality: No water quality data is known to be available for the project stream reaches. However, Allen Fork is a 303(d) Listed Impaired Water, with identified impairments such as sediment and nutrients attributed to habitat modification and urban stormwater.

Aquatic Community: No aquatic community data is known to be available for the project stream reaches, although the project's upper headwater streams (watershed < 1 square mile) are expected to provide habitat primarily for macroinvertebrates and amphibians, rather than fish. Completed habitat assessment forms for the major stream reaches are provided in Appendix B. The habitat assessment protocols were developed for larger streams and address fish habitat values, so scoring parameters have been modified to reflect natural conditions and values of upper headwater streams.

T/E Species: No threatened or endangered species are known to occur on the site or in the vicinity. As requested by USFWS (letter 6 June 2008), prior to disturbance the project limits will be surveyed for Running buffalo clover during the growing season, and potential Indiana bat roosting snags and trees.

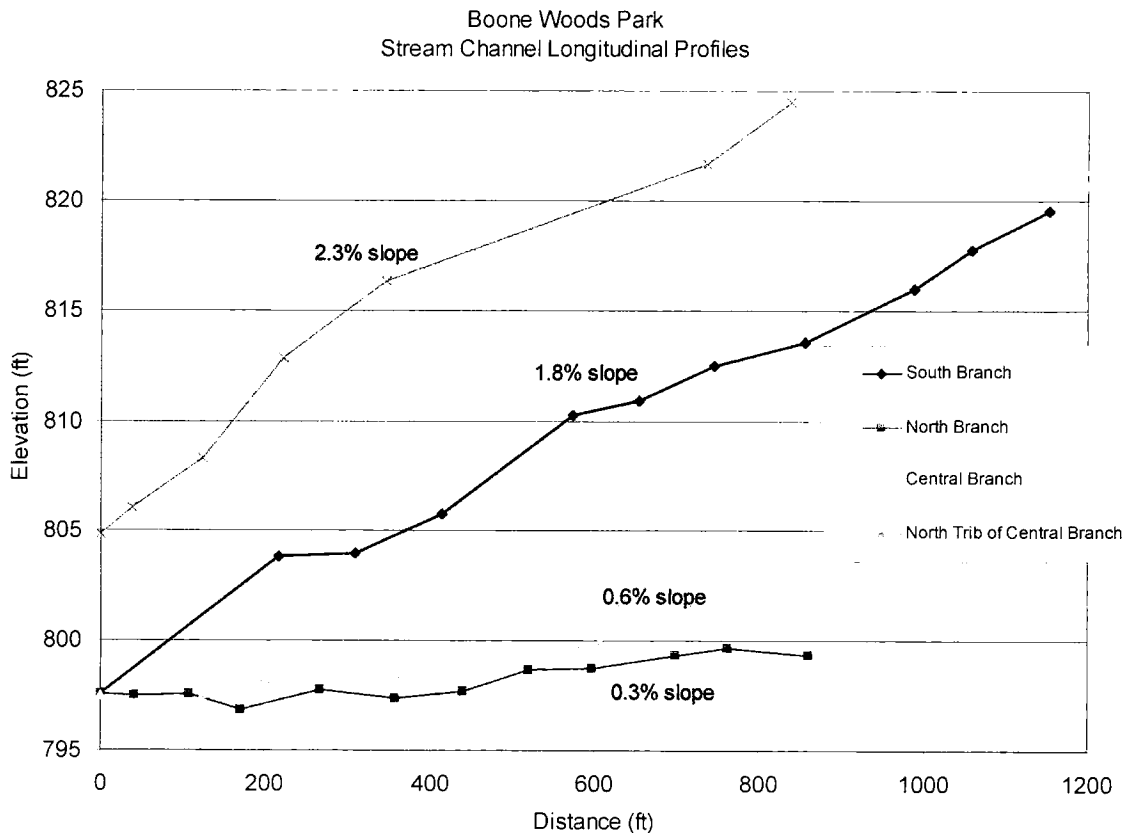
Cultural Resources: No significant cultural resources are known to occur on the site or in the vicinity. Based upon a project review by Kentucky Heritage Council no survey is necessary (letter 30 April 2008).

Technical Contact: Scott Fennell, PE, Center for Applied Ecology. 859-572-7588

Owner Contact: David Whitehouse, Director of Boone County Parks. 859-334-2117

WORK PLAN

In the following sections, descriptions of current conditions and restoration plans are provided. In addition, the locations of the four subject streams are illustrated on Figure 5, current stream conditions are scored in Appendix B, and longitudinal profiles are provided below.



Note that details of erosion control and riparian re-vegetation are described in Appendices C and D, not within the restoration task descriptions below. Excess soil generated from stream restoration will be placed on-site, mostly outside the riparian buffer, at upland locations to be agreed with the Parks Director.

Task 1 – North Branch Stream Restoration

Current Conditions – The North Branch drains a 372-acre watershed of primarily residential and undeveloped land (Figure 2). Compared to most northern Kentucky streams of similar watershed size, the channel slope is flat (0.3 percent) and the stream has a flat floodplain, now disconnected from the stream. The stream channel was historically straightened (1.04 sinuosity) and exhibits past downcutting and current widening (Rosgen G4/5; Channel Evolution Model Phase III). The floodprone width (2 X bankfull max depth) is within the 3-foot deep incised channel, and the steep banks lack significant riparian vegetation. The channel width at the top of

banks is 10 to 11 feet. The streambed is comprised primarily of sand or gravel with scattered flagstones, and the banks are primarily silt over clay. The depth to bedrock beneath the streambed varies from a few inches upstream to 2.5 feet downstream.



North Branch facing downstream. Stream condition at right (dry) due to extended drought.

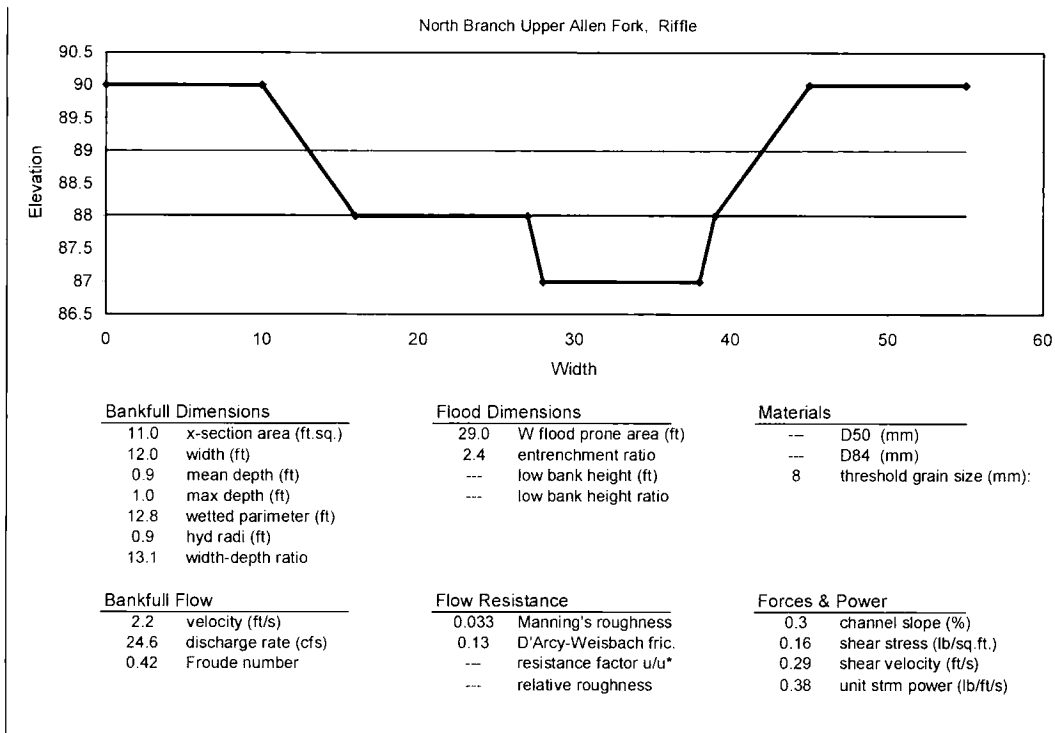
Restoration Plan – The North Branch is to be restored to a Rosgen Type C/E 4/5 meandering stream using a Priority 2 approach—maintaining the current channel elevation and excavating the banks to create a connected floodplain. Key parameters from a stable reference reach in an adjacent watershed, comparable in size and landuse, are:

- Bankfull width - 11 feet
- Mean depth - 18 inches
- Sinuosity - 1.26
- Channel slope - 0.8 percent
- Bed materials - sand and gravel with some small flagstones, some exposed bedrock.



Reference Reach facing downstream.

In order to increase the sinuosity of the stream, the stream length will be increased from 770 to 840 feet, relocating sections of the channel into the former floodplain to the extent practical, to achieve an increased sinuosity of 1.14 (Figure 6). The bankfull width of the restored channel will be 12 feet, with the floodplain elevation one foot above the streambed. The floodplain width will be 11 feet, with sideslopes above the floodplain sloped at 3:1, creating an entrenchment ratio of 2.4 (see cross section below).



Cross section and hydraulic calculations utilize Ohio DNR Reference Reach Survey 4-3 L.xls

Since the restored channel is somewhat wider and shallower than the reference reach, it is anticipated that sediment will drop out in the floodplain and narrow the channel (natural channel evolution from Rosgen C to E), which will reduce sediment in the stream and improve the soil quality of the floodplain, promoting improved vegetation. It will have the additional benefit of reducing the sediment load to the lake on the downstream property. Imported stone will not be placed in the riffles / crossovers or outside bends, unless determined to be necessary as a retrofit during the monitoring phase. Pools will be excavated on the outside of meander bends 18 inches below the riffle / crossover elevation (or to bedrock if shallower), consistent with naturally occurring pool depths in upper headwater streams.



Example Rosgen C3 Restoration at Florence Golf Course. Imported stone will not be used at Boone Woods unless necessary.

An ephemeral tributary to the North Branch is culvertized until it outlets at the park boundary. The watershed of the culvert is approximately 8 acres of residential land, and the on-property channel is approximately 100 feet of riprap, gully, and fescue swale. In

order to improve water quality, provide additional habitat diversity, and recharge baseflow, the channel will be reconstructed and diverted to a stormwater wetland constructed within the former floodplain, ranging in depth from zero to 24 inches deep. The model for the construction will be a similar stormwater wetland constructed for the Bentwood Hills project, which has been demonstrated to provide good amphibian and reptile habitat.

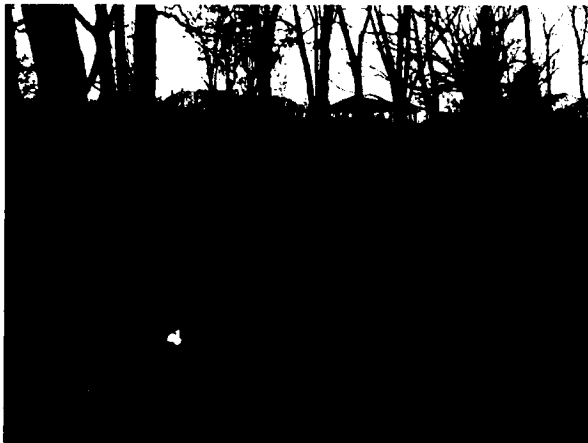


Example small stormwater wetland at Bentwood Hills.

Additional tasks such as the removal of stream and floodplain obstructions, the relocation of the disc golf course, and riparian re-vegetation are addressed under Task 4.

Task 2 – Central Branch Bank and Channel Stabilization

Current Conditions – The Central Branch drains 280 acres of residential, recreational, and commercial land (Figure 2), and was historically straightened and moved to the edge of the valley to maximize past agricultural landuse. The 0.6 percent channel is recovering some sinuosity, but is undercutting approximately 660 feet of left descending bank. The right descending floodplain is mowed and utilized for picnicking and outdoor fairs, in some places within 25 feet of the bank.



Undercutting left descending bank at Boone Woods. Boulder deflectors at Adair WMA.

An intermittent tributary discharges to the Central Branch from the north. The upper 500 feet of the 2.3 percent tributary stream is forested, while the lower 500 feet flows through turf grass. The disc golf course crosses or encroaches on the channel at several locations, and 120 feet is culvertized just above the confluence.

Restoration Plan – In order to reduce sediment in the stream and protect the riparian forest buffer, the left descending bank will be stabilized using boulder deflectors to divert flow away from the toe of slope. In addition to protecting against continued undercutting, it is likely that sediment will accumulate upstream of each deflector, and scour pools will develop downstream of the deflectors, improving bank vegetation and aquatic habitat. Deflector sites will be determined in the field based upon the location of trees, stream flow direction, etc. but are anticipated to be spaced no closer than one bankfull width apart (13 feet) on average. To prevent flanking, the top of the deflectors will extend above the bankfull elevation, and the ends will be keyed into the banks to the extent practicable, while preserving trees, etc.



Downstream view of Central Br Trib.

Near the upstream end of the Central Branch, a sanitary sewer aerial crossing and bridge have been stabilized with grout on a 25 ft length of stream channel. The grout is being flanked and undercut, and will be removed. In place of the grout, the channel bed will be stabilized using a boulder cross vane (see below). The invert of the vane will be in the approximate center of the channel to direct and concentrate flow, and the bank ends will extend to at least bankfull elevation plus six inches to protect against flanking. Similar to the boulder deflectors, sediment deposition is expected on the upstream banks, and a scour pool is expected to form downstream, improving bank vegetation and aquatic habitat diversity.



Failing grout in the channel at Boone Woods. Boulder cross vane at Woodland Hills.

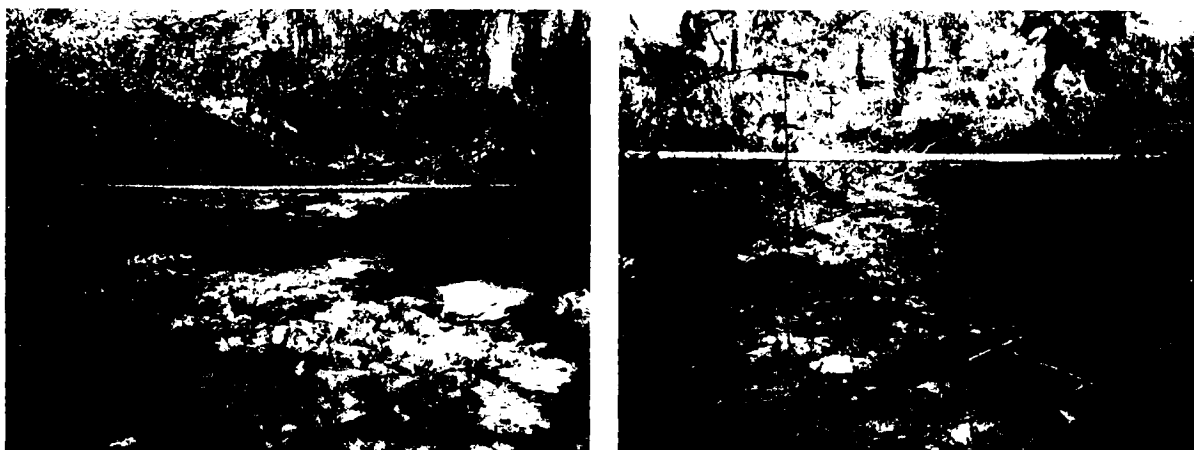
Miscellaneous subtasks for the Central Branch will be removing grouted riprap from two locations on the right bank, excavating two point bars to reduce outside bend stress, 3:1 sloping of 75 feet of 4-foot vertical bank, and repairing 60 feet of ephemeral tributary that drains over the steep left bank as a gully.

Tasks such as the removal of additional stream and floodplain obstructions, the relocation of the

electric service and grills, relocation of the disc golf course, and riparian re-vegetation are addressed under Task 4.

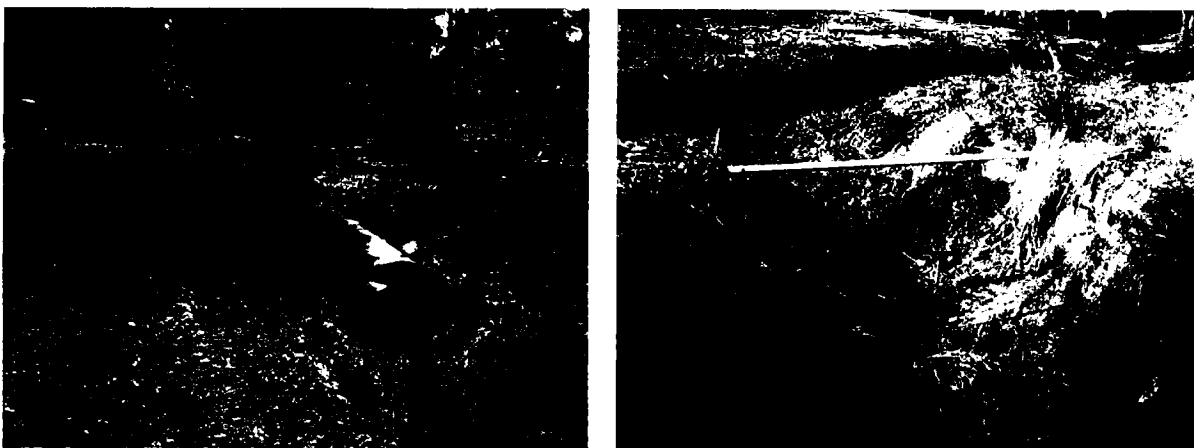
Task 3 – South Branch Restoration

Current Conditions – The South Branch drains a 38-acre watershed of residential and recreational land and has a slope of 1.8 percent. The upper half of the on-property reach is forested, and approximately 500 feet of the forested reach exhibits past downcutting and current widening (Rosgen G3/4; Channel Evolution Model Phase III). The channel bed is mostly gravel and small flagstones.



Relatively stable forested reach (left) and incised forested reach (right) on South Branch.

The lower half of the South Branch runs through turf grasses, and the channel bed is comprised of approximately 3 feet of fine sediments (clay silt) over bedrock. A 30-inch culvert is providing grade control. Upstream of the culvert, approximately 140 feet of stream is a relatively stable Rosgen E6 channel. Below the culvert, approximately 200 feet of stream exhibits downcutting and widening (Rosgen G6; Channel Evolution Model Phase II / III) until entering another Rosgen E6 reach. Measured from the top of banks, the incised channel width is about 7 feet, and the depth is about 3 feet, so that the floodprone width is within the incised channel.



Relatively stable non-forested reach (left) and incised reach (right) above and below culvert on South Branch.

Restoration Plan – The approximately 700 feet of incised reach will be restored to a Rosgen B3/4c (<2% slope) channel using a Priority 2 approach—maintaining the existing channel elevation. Based upon regional reference reaches and the stable upstream reach, the bankfull width should be 10 to 12 feet at a mean depth of about 1 foot. To the extent practical, the incised reaches will be widened to the reference width, and either a bankfull bench constructed, or the floodprone width maximized, while preserving desirable trees and creating flatter slopes (3:1) to facilitate revegetation (i.e., the desired bankfull width may not be achievable in the entire reach). Additionally, in the lower non-forested section, oversize gravel (or flagstone, if available) will be placed in the streambed to prevent continued downcutting, and to enhance habitat value. The 30-inch culvert will be removed and replaced with a stone ford at the same invert elevation, to facilitate mowing vehicle access across the channel, and to provide continued grade control.



Incised / sediment-filled channel restored to Rosgen A/B channel with floodprone width at Adair WMA.

Task 4 – Conservation Area Restoration and Preservation

Current Conditions – As previously described, the riparian zone and streams are highly impacted by uses such as the disc golf course, picnicking, occasional fairs, etc. For example, disc golfers are frequently on the banks and in the stream channels recovering discs. Various stream and floodplain obstructions include footbridges, culverts, disc golf tees and nets, electric service, etc.

Approximately half of the proposed riparian buffer is vegetated with turf grasses mowed to the top of the banks. Approximately half the riparian buffer is forested, varying from high quality forest (low invasives; larger crown trees) to low quality (high invasives, young trees).



Foot bridge and undermined abutment to be removed. Stone to be re-used in the channel.

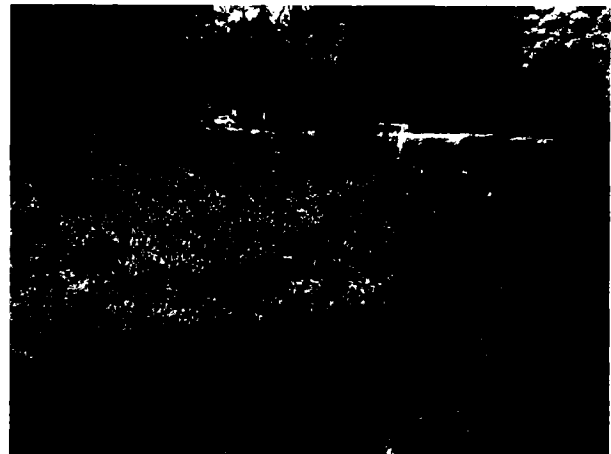
Restoration Plan – A 12.5-acre riparian buffer will be established along the length of the subject streams averaging about 50 feet from each bank. Along portions of the Central and South Branches, the riparian buffer will be as narrow as 25 feet due to the close proximity of park features such as electric service, grills, picnic tables, and a shelter.

The following obstructions will be removed from the streams or riparian buffer: old pasture fence and posts, stone stairs, 5 of 8 timber foot bridges, and 2 culverts. The following obstructions/impairments will be relocated outside the riparian buffer: 4 electric service boxes and 2 charcoal grills to at least 25 feet from the streams, and 13 (+/-) disc golf tees or baskets to at least 50 feet from the streams. In consultation with the Parks Department, the entire disc golf course will be reconfigured to minimize in-play zones within or crossing the riparian buffer and streams.



Culvert replaced by stone ford at Adair WMA.

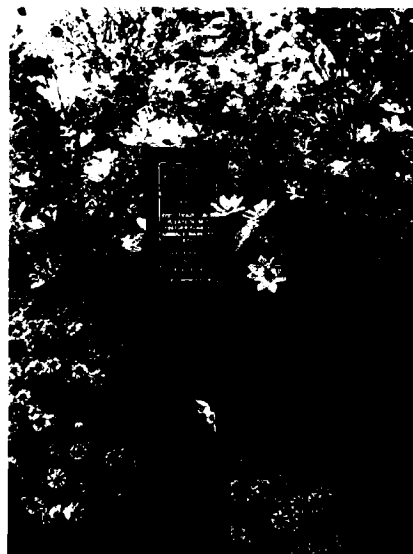
Turf grasses in the non-forested areas of the riparian zone will be eradicated and replaced with native grasses, wildflowers, shrubs, and trees. Existing forests will be enhanced by removing invasive woody vegetation such as bush honeysuckle and multiflora rose, and turfgrasses where present. Supplemental shrubs and trees will be planted in forested areas where natives are scarce. In areas where the disc golf course crosses the riparian buffer, the in-play areas may be maintained as native meadow by periodic mowing (e.g., annually in the fall). The re-vegetation plan is detailed in Appendix D.



Example native meadow plantings at Woodland Hills.

In order to inform both visitors and park managers of the existence and purpose of the project, and to promote proper stewardship of this natural area, the following steps will be taken:

- The riparian buffer perimeter will be surveyed and posted at 150- to 200-foot



Natural area boundary marker.



Interpretive sign (2' x 3').

intervals, including a no-mowing label (except where managed as native meadow).

- An interpretive natural area sign will be installed at a conspicuous location.
- Access control fencing (e.g., spit rail fence) will be installed along reaches of the stream particularly vulnerable to damage from frequent visitor access.

Permitting – Permits, sign-offs, and/or notices believed to be applicable to this project are tabulated below (indicated by √). Agencies will be contacted to verify permitting requirements:

	<i>Issue</i>	<i>Permit / Notice</i>	<i>Agency</i>
√	Filling of Waters of US	CWA Sec 404 NWP 27	Corps of Engineers
√	Water Quality	CWA Sec 401 Water Quality Cert.	KY Div of Water
√	Stormwater Mgmt	Land Disturbance Permit if > 1 acre	Sanitation District 1
√	Stormwater Mgmt	48-Hour Notice of Intent if > 1 acre	KPDES Branch
√	Floodplains	Stream Construction Permit (SCP) *	KY Water Resources Branch
√	Floodplains	SCP Application Review & Sign-off	Local Floodplain Coord.
√	Grading	Grading Permit	Boone County
√	T&E Species - plants	Notice	KSNPC & USFWS
√	T&E Species - wildlife	Notice	KDFWR & USFWS
√	Cultural Resources	NHPA Sec 106 Review	Kentucky Heritage Council

* - Public notice in local newspaper may be required concurrent with permit application.

PERFORMANCE STANDARDS

Performance Standards for each restoration task are summarized below. Note that the Watershed Watch Habitat Assessment (equivalent to USEPA RBP) was developed for fish habitat potential in larger headwater streams (e.g., watershed area 3 – 5 sq mi) and has been modified to reflect the different habitat potential of steeper (> 2%) and/or smaller watershed (< one sq mi) streams, which are primarily habitat for macroinvertebrates, reptiles and amphibians rather than fish. For example, a riffle/pool pattern does not generally occur in channels steeper than two percent slope, velocity/depth regimes such as deep/fast do not naturally occur in small channels, and epifaunal substrate may be naturally scarce in small silt-bed Rosgen E channels.

<i>Task</i>		<i>Geomorphology</i>	<i>Habitat</i>	<i>Vegetation</i>
1	North Branch	Stable channel banks & bed based upon visual assessment at least annually.	KDOW Watershed Watch Habitat Assessment--Modified scoring for steep-gradient (>2%) or upper-headwater streams (< one sq mi watershed). Pre-Construction (see Appendix B) then Years 1, 3 & 5.	See Task 4
2	Central Branch and Tributary			
3	South Branch			
4	Conservation Area Restoration and Preservation	600 native stems/acre (incl volunteers); < 5% woody non-native invasives. Report species list, wetland indicator status, and relative abundance of native woody plants Years 1, 3 & 5.		

DETERMINATION OF CREDITS

The following table provides an estimate of the adjusted mitigation units (credits) to be generated by the project, based upon a scoring system developed by the Louisville District Corps of Engineers. Scoring will be finalized at the end of the 5-year maintenance and monitoring phase based upon actual before and after project conditions.

Impacts

Water Body	Type	Quality				Impact Type	Linear Ft	Area (acres)	Ratio	Final Adjusted Areal Impacts	Final Adjusted Linear Impacts
North Branch - RPW	Per	Poor				fill for new channel creation	330	0.083	1.50		495.0
North Branch Trib	Eph	Poor				fill for new channel creation	50	0.013	0.50		25.0
Total							380	0.096			520.0

Mitigation

Water Body	Type	Initial Quality	Initial Ratio	Final Quality	Final Ratio	Mitigation Type	Area	Linear Ft	Mit. Ratio	Final Adjusted Areal Mitigation Units	Final Adjusted Linear Mitigation Units
North Branch - RPW	Per	0	0.00	Exc	3.00	New channel w/50 ft buffer each side		70	1.00		210.0
North Branch - RPW	Per	Poor	1.50	Exc	3.00	Priority 2 restoration with floodplain creation, obstruction removal, and 50 ft buffer each side		770	1.00		1155.0
North Branch Trib	Eph	Poor	0.50	Exc	1.00	Stream relocation, diversion to stormwater wetland w 50 ft buffer ea side		100	1.00		50.0
North Branch Trib stormwater wetland						Wetland creation by excavation	0.10		0.50	0.1	
Central Branch - RPW	Per	Poor	1.50	Exc	3.00	Bank and channel stabilization and obstruction removal, w 50 ft buffer left side, 25 ft buffer right side		1000	0.70		1050.0
Central Branch Eph Trib	Eph	Poor	0.50	Exc	1.00	Channel reconstruction w 50 ft buffer ea side		60	0.70		21.0
Central Branch Int Trib	Int			Exc	2.00	50 + ft buffer enhancement w inv species removal, disc golf relocation, and native plantings		900	0.22		396.0
South Branch	Int	Poor	1.00	Exc	2.00	Priority 2 restoration with floodprone width creation, obstruction removal, and 50 ft buffer each side		700	1.00		700.0
South Branch	Int			Exc	2.00	50 + ft buffer enhancement w inv species removal, disc golf relocation, and native plantings		336	0.22		147.8
TOTAL								3,936		0.1	3,729.8

Net Mitigation - Adjusted Mitigation Units:

3,210

MAINTENANCE & MONITORING PLAN

All projects implemented by the Center for Applied Ecology entail project observation and direction by the restoration design professionals during construction, including observation and direction for all critical activities.

Approximately one year after substantial completion of stream restoration activities, an As-Built Report and First Year Monitoring Report will be submitted. (Completion of riparian re-vegetation may not be completed until the following year.) Deviations from the approved Plan will be documented in the As-Built.

Project maintenance and monitoring will be conducted by the Center for Applied Ecology at least annually for five years after substantial completion of stream restoration. During the maintenance & monitoring period, minor maintenance is anticipated for such things as localized bank erosion and control of invasive vegetation to ensure the project achieves the Performance Standards outlined above. Monitoring results, minor maintenance, and any Corps-approved corrective actions (see Adaptive Management Plan below) will be documented using maps, photos, tables, and graphs.

Monitoring reports will be submitted biannually (Year 1, Year 3, and Year 5) to maximize project cost-effectiveness.

LONG-TERM MANAGEMENT PLAN

The project is designed to be self-sustaining and no long-term management is anticipated other than site protection. After the five-year maintenance and monitoring phase, the easement holder will conduct occasional inspections of the conservation area to ensure the terms of the easement are maintained, and will replace broken or missing boundary signs as necessary. Conservation easement management funding is discussed under Financial Assurance.

ADAPTIVE MANAGEMENT PLAN

The project is to be constructed, managed, and monitored by the Center for Applied Ecology.

During construction, opportunities will be considered to improve project results or achieve cost savings. These may include construction adjustments to save desirable trees and other vegetation, utilizing alternative sources of stone, minor changes to incorporate innovative or demonstration techniques and materials, etc. Projects adjustments may also be required to address unforeseen circumstances, such as the discovery of refuse/waste or cultural resources, or additional restoration opportunities.

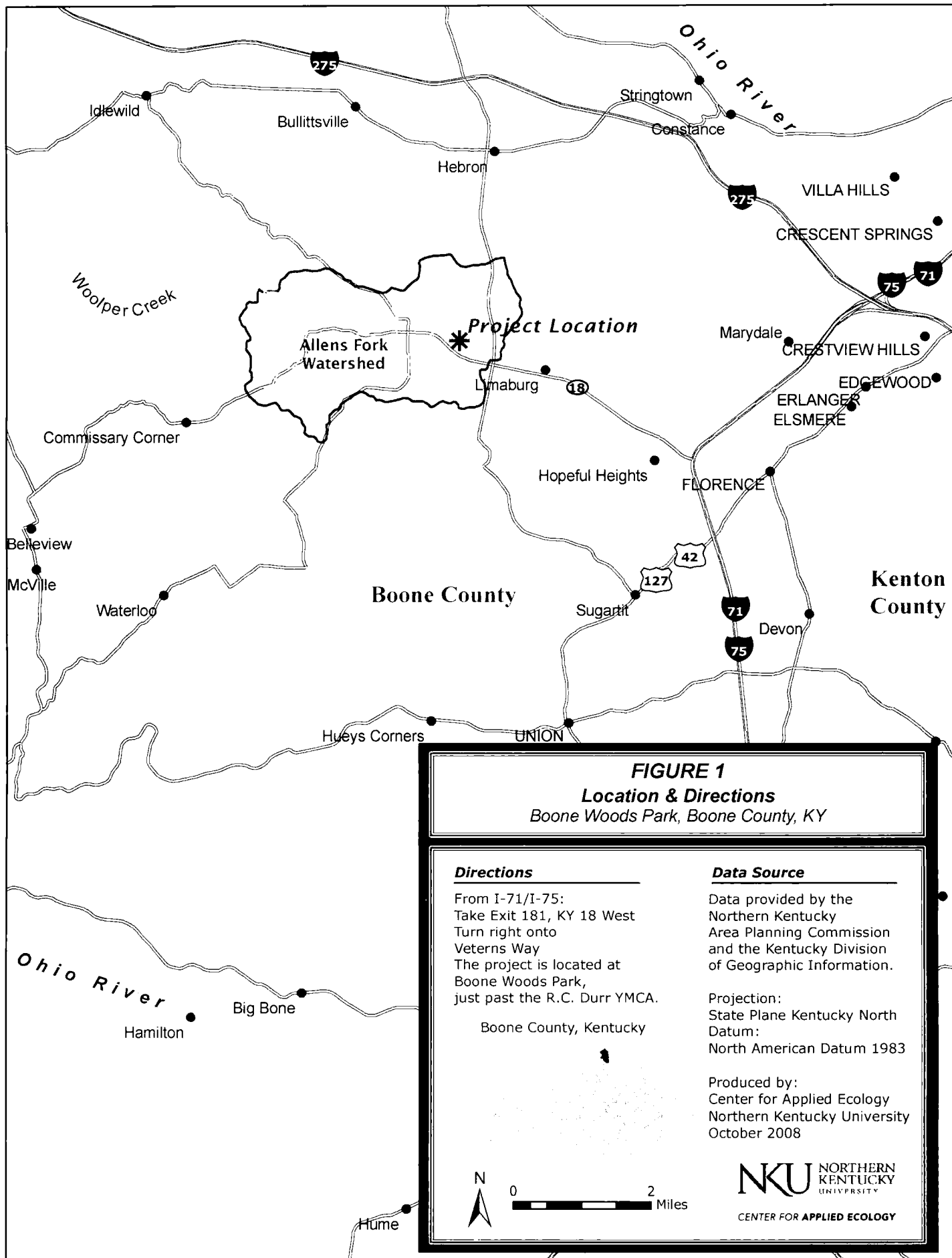
If monitoring results indicate a significant failure to meet Performance Standards (i.e., beyond anticipated minor maintenance), the Corps of Engineers will be consulted as to whether

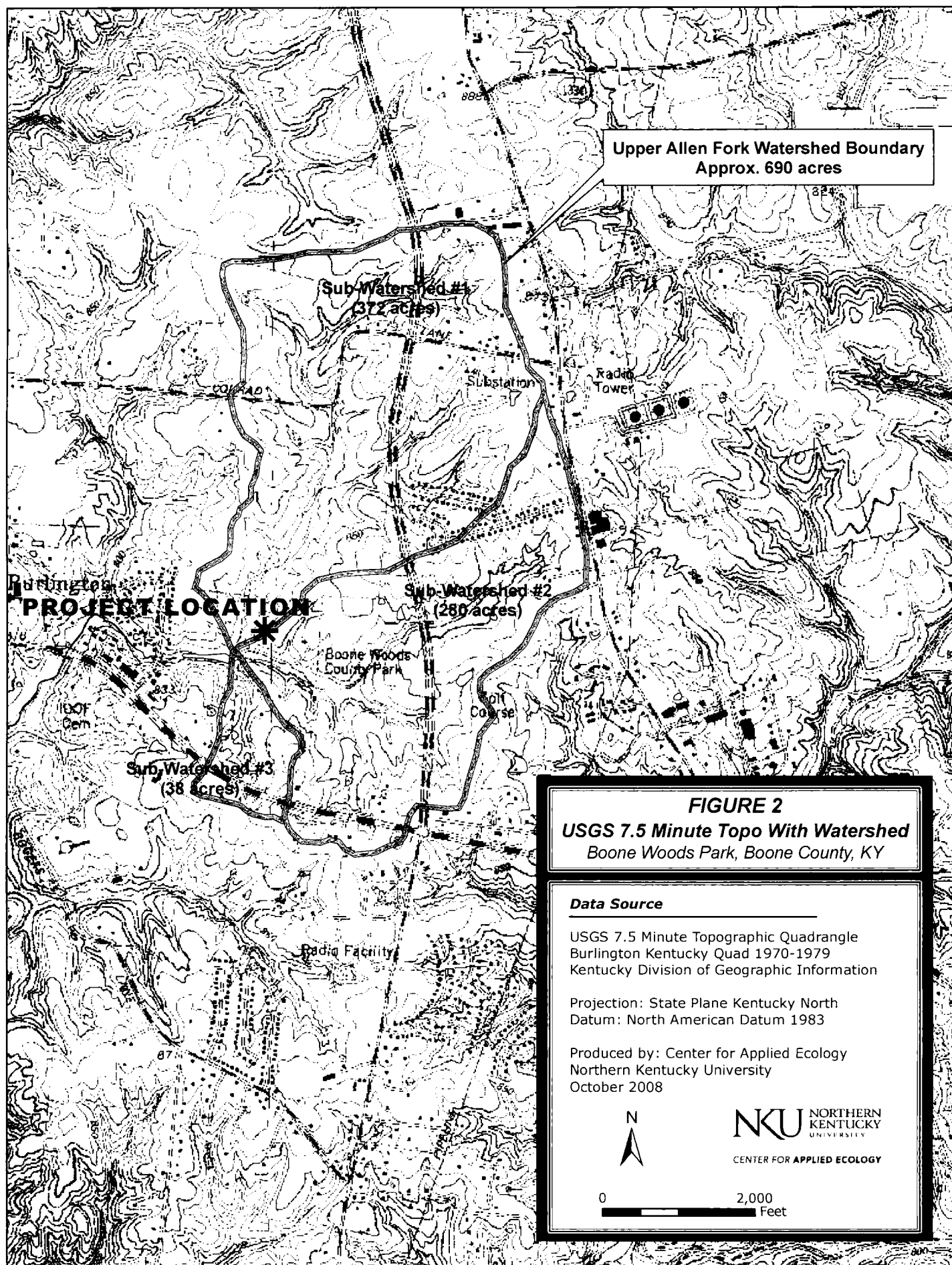
corrective action is required, and if so, they will be implemented as expeditiously as practicable. Alternatively, project credits may be adjusted to reflect a lower credit value if standards are not practically and cost-effectively achievable, or the period of maintenance & monitoring may be extended beyond five years until standards are achieved.

FINANCIAL ASSURANCE

Project funding is to be approved by the IRT and is currently available and earmarked within the Northern Kentucky Stream & Wetland Restoration Fund (NKSWRF). The project budget includes a contingency / reserve fund and a five-year maintenance and monitoring budget. Additionally, a non-wasting endowment has been established to fund perpetual conservation easement monitoring to ensure the project area remains a natural area. The Conservation Easement Fund (CEF) is managed by the easement holder, the Northern Kentucky University Research Foundation (NKURF). Both the NKSWRF and CEF are subject to annual auditing and reporting to the Louisville District Corps of Engineers.

APPENDIX A – FIGURES





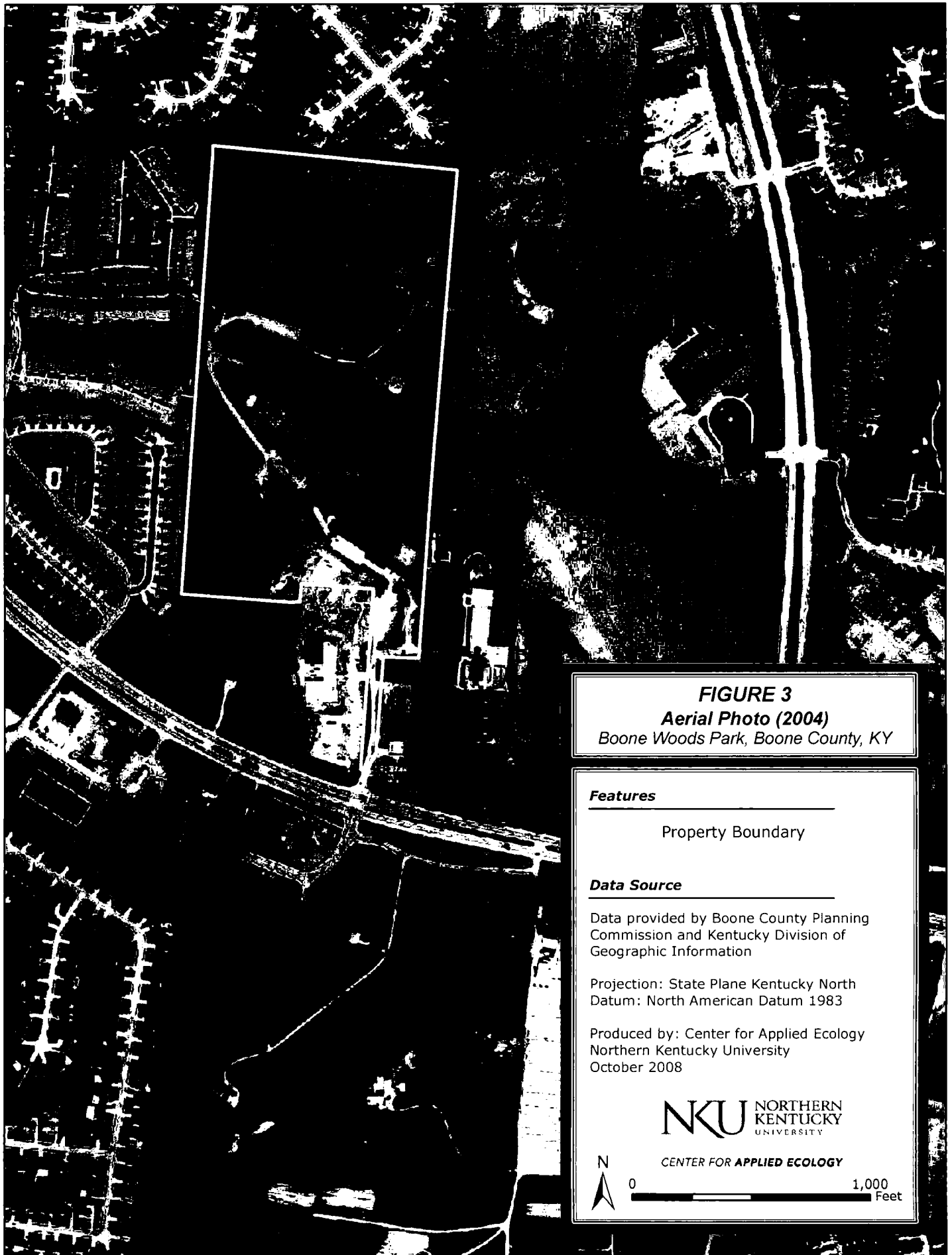


FIGURE 3
Aerial Photo (2004)
Boone Woods Park, Boone County, KY

Features

Property Boundary

Data Source

Data provided by Boone County Planning Commission and Kentucky Division of Geographic Information

Projection: State Plane Kentucky North
Datum: North American Datum 1983

Produced by: Center for Applied Ecology
Northern Kentucky University
October 2008

NKU NORTHERN
KENTUCKY
UNIVERSITY

CENTER FOR APPLIED ECOLOGY



0 1,000 Feet

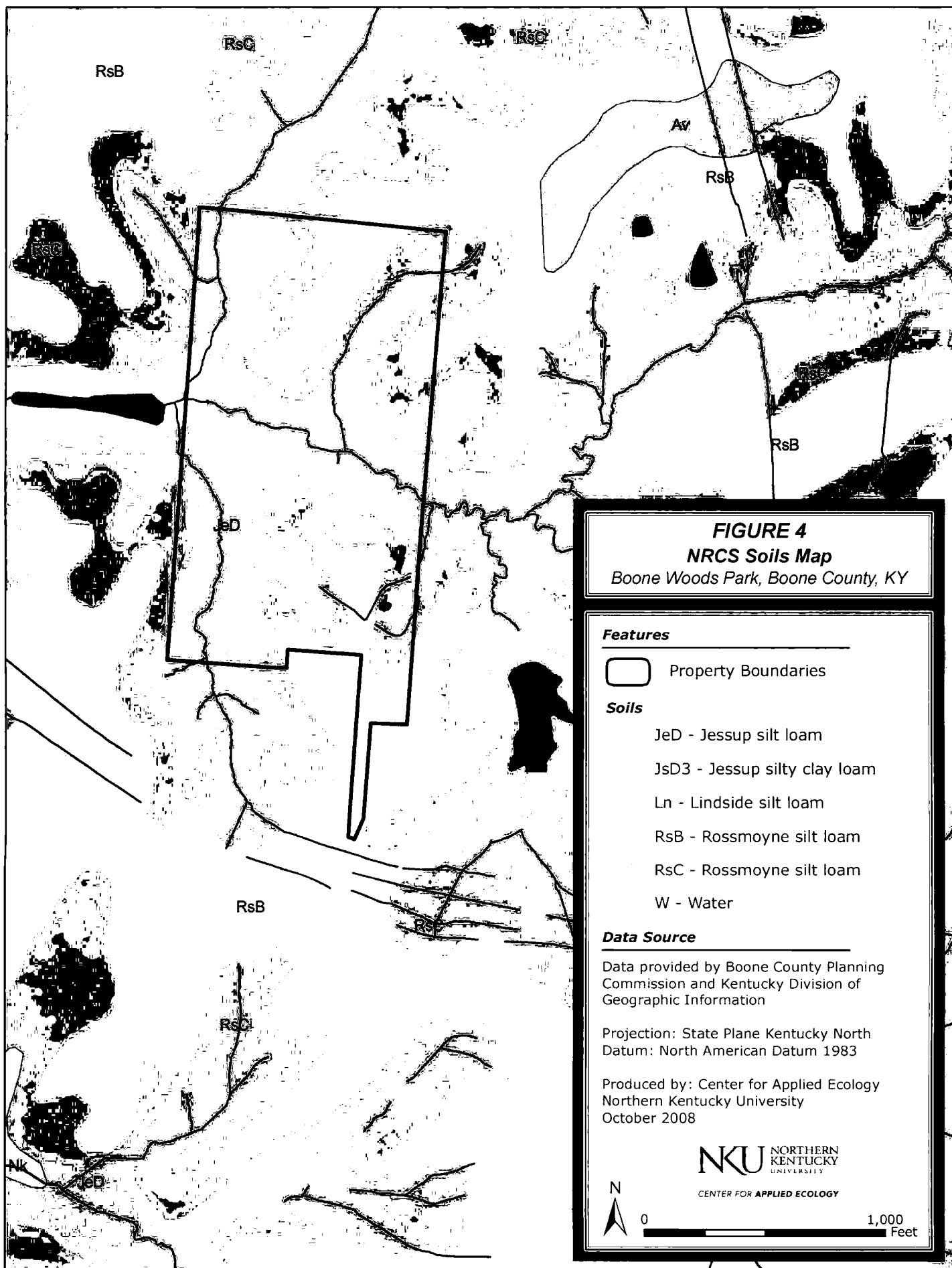


FIGURE 5
Project Task Locations
 Boone Woods Park, Boone County, KY

NKU
 NORTHERN
 KENTUCKY
 UNIVERSITY
 CENTER FOR APPLIED ECOLOGY



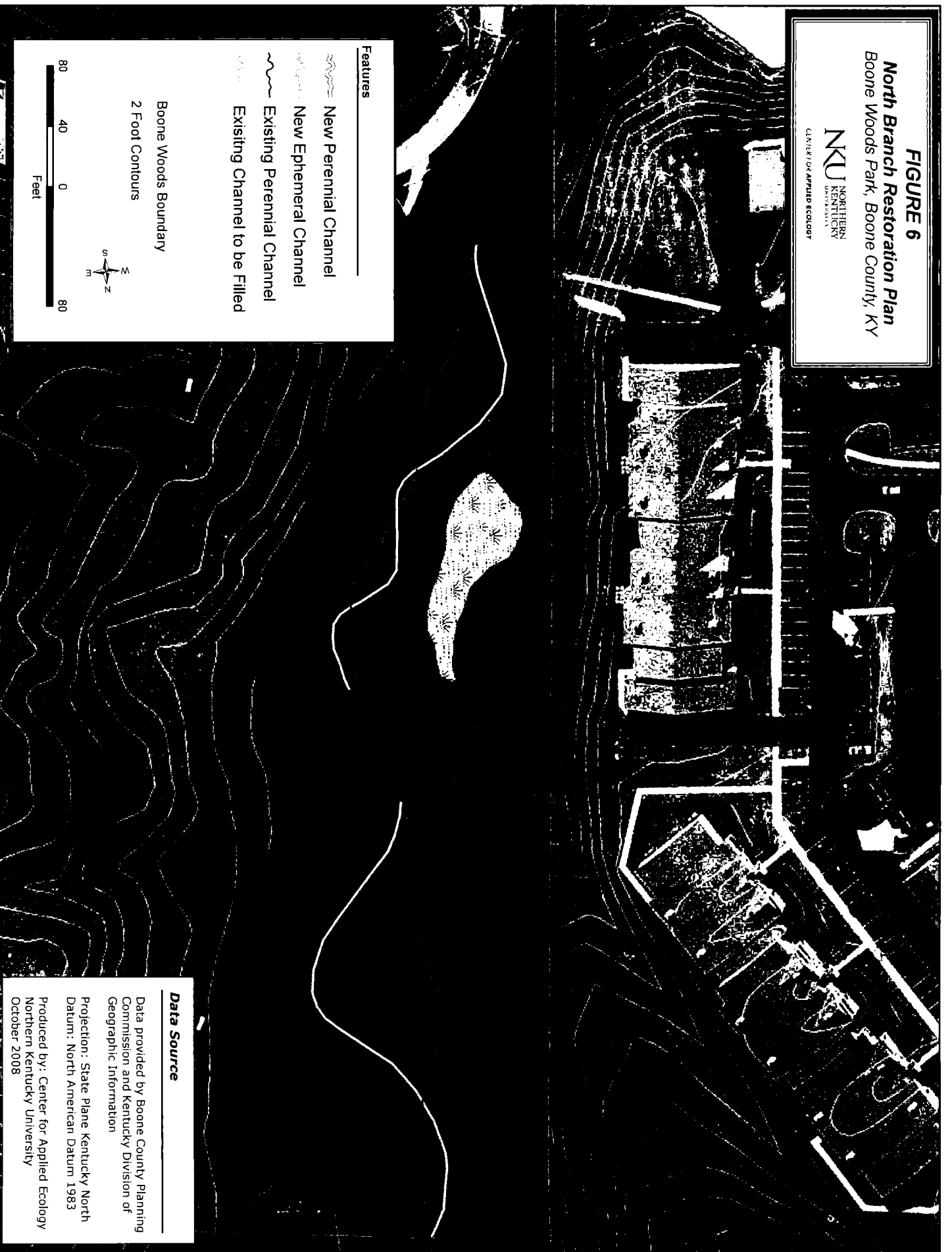
Data provided by Boone County Planning Commission and Kentucky Division of Geographic Information

Projection: State Plane Kentucky North Datum: North American Datum 1983

Produced by: Center for Applied Ecology
 Northern Kentucky University
 October 2008

FIGURE 6
North Branch Restoration Plan
Boone Woods Park, Boone County, KY

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UNIVERSITY
CENTER FOR APPLIED ECOLOGY



Data Source

Data provided by Boone County Planning
Commission and Kentucky Division of
Geographic Information








Projection: State Plane Kentucky North
Datum: North American Datum 1983

Produced by: Center for Applied Ecology
Northern Kentucky University
October 2008

FIGURE 7 **Restoration & Preservation Area** Boone Woods Parks, Boone County, KY

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Features

-  Conservation Area
-  Existing Bridge to be maintained
-  Existing Bridge to be Removed
-  Culvert to be Removed
-  Boone Woods Boundary
-  2 foot Contours
-  Streams (Boone County GIS)

150 75 0 150
 Feet



Data Source

Data provided by Boone County Planning
 Commission and Kentucky Division of
 Geographic Information
 Projection: State Plane Kentucky North
 Datum: North American Datum 1983
 Produced by: Center for Applied Ecology
 Northern Kentucky University
 October 2008

APPENDIX B – HABITAT ASSESSMENT FORMS
(Modified Scoring for Upper Headwater Streams)

NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

STREAM NAME: <u>Allen Fork, North Branch</u>		LOCATION: <u>North Branch</u>																					
STATION #: <u>5</u> MILE:		BASIN/WATERSHED:																					
LAT.:	LONG.:	COUNTY: <u>Boone</u>	USGS 7.5 TOPO:																				
DATE: <u>11/13/08</u> TIME: <u>3:40</u>		INVESTIGATORS: <u>Crystal C., Dianne W., J. J. Clark</u>																					
TYPE SAMPLE: <input type="checkbox"/> P-CHEM <input type="checkbox"/> Macroinvertebrate <input type="checkbox"/> FISH <input type="checkbox"/> BACT. <u>Ma</u>																							
<input type="checkbox"/> Stream restoration, completion date																							
WEATHER: Now <input type="checkbox"/> Past 24 hours <input type="checkbox"/> <u>Cloudy</u> <input type="checkbox"/> Heavy rain <input type="checkbox"/> <input type="checkbox"/> Steady rain <input type="checkbox"/> <input type="checkbox"/> Intermittent showers <input type="checkbox"/> <input type="checkbox"/> Clear/sunny <input type="checkbox"/>		Has there been a heavy rain in the last 7 days? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No ≈ 0.5 Air temperature _____ °C. Inches rainfall in past 24 hours _____ in. <u>75</u> % Cloud Cover																					
P-Chem: Temp (°C) _____ D.O. (mg/l) _____ % Saturation _____ pH (S.U) _____ Cond. _____ <input type="checkbox"/> Grab																							
INSTREAM WATERSHED FEATURES: Stream Width (riffle, bankfull) <u>8</u> ft Range of Pool Depths _____ ft Average Velocity <u>X</u> ft/s Est. Reach Length _____ ft* *Scoring is based on entire restoration reach; not limited to 100 m segment.		LOCAL WATERSHED FEATURES: Predominant Surrounding Land Use: <input type="checkbox"/> Surface Mining <input type="checkbox"/> Construction <input type="checkbox"/> Forest/Silviculture <input checked="" type="checkbox"/> Lawn <input checked="" type="checkbox"/> Commercial <input type="checkbox"/> Pasture/Grazing <input checked="" type="checkbox"/> Park <input type="checkbox"/> Industrial <input type="checkbox"/> Hay <input type="checkbox"/> Land Disposal / Dumps <input type="checkbox"/> Row Crops <input checked="" type="checkbox"/> Urban Runoff/Storm Sewers																					
Hydraulic Structures: <input type="checkbox"/> Dams <input checked="" type="checkbox"/> Bridge Abutments <input type="checkbox"/> Island <input type="checkbox"/> Waterfalls <input type="checkbox"/> Other		Stream Flow: <input type="checkbox"/> Dry <input type="checkbox"/> Pooled <input type="checkbox"/> Low <input checked="" type="checkbox"/> Normal <input type="checkbox"/> High <input type="checkbox"/> Very Rapid or Torrential																					
Riparian Vegetation: Dom. Tree/Shrub Taxa Dominate Type <input type="checkbox"/> Trees <input type="checkbox"/> Shrubs <input checked="" type="checkbox"/> Grasses <input type="checkbox"/> Herbaceous Number of strata		Canopy Cover: <input type="checkbox"/> Fully Exposed (0-25%) <input checked="" type="checkbox"/> Partially Exposed (25-50%) <input type="checkbox"/> Partially Shaded (50-75%) <input type="checkbox"/> Fully Shaded (75-100%)																					
Channel Alterations: <input type="checkbox"/> Dredging <input type="checkbox"/> Channelization (<input type="checkbox"/> Full <input type="checkbox"/> Partial)		Riffle-riffle slope _____ Rosgen channel type _____ Channel Evol. Model _____																					
Stream Quality Good (G) Fair (F) Poor (P) Rosgen C >155 142-155 <142 Other >77.5% 71-77.5% <71%		<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <th></th> <th>Score</th> <th>Possible Pts</th> <th>%</th> <th>Condition (G, F, P)</th> </tr> <tr> <td>Former</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Existing</td> <td align="center"><u>94</u></td> <td align="center"><u>160</u></td> <td align="center"><u>59</u></td> <td align="center"><u>P</u></td> </tr> <tr> <td>Future**</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>			Score	Possible Pts	%	Condition (G, F, P)	Former					Existing	<u>94</u>	<u>160</u>	<u>59</u>	<u>P</u>	Future**				
	Score	Possible Pts	%	Condition (G, F, P)																			
Former																							
Existing	<u>94</u>	<u>160</u>	<u>59</u>	<u>P</u>																			
Future**																							
NOTE: Rosgen C (<2% slope) based on scoring of all 10 parameters below; Rosgen E may exclude #2, 3, and 7 below; Rosgen A/B may exclude #3 and 5 below; other exclusions on a site specific basis.		**Estimated future score based on the following: <input type="checkbox"/> In-Stream Habitat, <input type="checkbox"/> NCD Stream Restoration, <input type="checkbox"/> Bank Stabilization, <input type="checkbox"/> Future <input type="checkbox"/> Canopy/Riparian Vegetation, <input type="checkbox"/> Other																					
Habitat	Condition Category																						
Parameter	Optimal	Suboptimal	Marginal	Poor	Comment																		
1. Epifaunal Substrate/Available Cover <div style="text-align: center; font-size: 2em;">✓</div>	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.																			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 <u>7</u> 6	5 4 3 2 1 0																			
2. Embeddedness <div style="text-align: center; font-size: 2em;">✓</div>	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.																			
SCORE	20 19 18 17 <u>16</u>	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0																			
3. Velocity/Depth Regime <div style="text-align: center; font-size: 2em;">X</div>	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).																			
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0																			

NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

4. Sediment Deposition ✓	Little or no enlargement of islands or point bars and less than 5% (< 20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
5. Channel Flow Status X	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
6. Channel Alteration ✓	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	alteration more from urban Run off
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
7. Frequency of Riffles (or bends) ✓	Occurrence of riffles relatively frequent; ratio distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. <i>Riffles are more Distance between them vary</i>	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.	Continuous riffle can be "good" 12-80 ft between riffles 5.6 = ± 45 average ± 8 ft wide
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
8. Bank Stability (score each bank) ✓	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	
9. Vegetative Protection (score each bank) ✓	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	
10. Riparian Vegetative Zone Width (score each bank) ✓	Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone < 6 meters; little or no riparian vegetation due to human activities.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	

Total Score:

94

NOTES/COMMENTS:

2

NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

STREAM NAME: <u>Allen Fork, Central Branch</u>		LOCATION: <u>Central Branch</u>	
STATION #: <u>5</u> MILE:		BASIN/WATERSHED:	
LAT.: LONG.:		COUNTY: <u>Boone</u> USGS 7.5 TOPO:	
DATE: <u>11/13/08</u> TIME: <u>3:40pm</u>		INVESTIGATORS: <u>Crystal C., Dianner W., JT O., Mark L.</u>	
TYPE SAMPLE: <input type="checkbox"/> P-CHEM <input type="checkbox"/> Macroinvertebrate <input type="checkbox"/> FISH <input type="checkbox"/> BACT.			

☐ Stream restoration, completion date

WEATHER: <i>Cloudy</i>	Now	Past 24 hours	Has there been a heavy rain in the last 7 days? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Air temperature ____ °C. Inches rainfall in past 24 hours <u>.5</u> in. <u>95%</u> Cloud Cover
	<input type="checkbox"/>	<input type="checkbox"/> Heavy rain	
	<input type="checkbox"/>	<input type="checkbox"/> Steady rain	
	<input type="checkbox"/>	<input type="checkbox"/> Intermittent showers	
	<input checked="" type="checkbox"/> Clear/sunny		

P-Chem: Temp (°C) D.O. (mg/l) % Saturation pH (S.U) Cond. ☐ Grab

INSTREAM WATERSHED

FEATURES:

Stream Width (riffle, bankfull) ____ ft
 Range of Pool Depths ____ ft
 Average Velocity X ft/s
 Est. Reach Length ____ ft*

*Scoring is based on entire restoration reach; not limited to 100 m segment.

LOCAL WATERSHED FEATURES:

Predominant Surrounding Land Use:

☐ Surface Mining ☐ Construction ☐ Forest/Silviculture
☒ Lawn ☒ Commercial ☐ Pasture/Grazing
☒ Park ☐ Industrial ☐ Hay
☐ Land Disposal / Dumps ☐ Row Crops ☒ Urban Runoff/Storm Sewers

Hydraulic Structures:

☐ Dams ☒ Bridge Abutments *outside bend*
☐ Island ☐ Waterfalls
☐ Other

Stream Flow:

☐ Dry ☐ Pooled ☐ Low ☒ Normal
☐ High ☐ Very Rapid or Torrential

Stream Type:

☒ Perennial ☐ Intermittent
☐ Ephemeral ☐ Seep

Riparian Vegetation:

Dom. Tree/Shrub Taxa

Dominate Type
☒ Trees ☐ Shrubs *lawn*
☒ Grasses ☐ Herbaceous *ash/walnut*
 Number of strata

Canopy Cover:

☐ Fully Exposed (0-25%)
☐ Partially Exposed (25-50%)
☒ Partially Shaded (50-75%)
☐ Fully Shaded (75-100%)

Channel Alterations:

☐ Dredging
☐ Channelization
 (☐ Full ☐ Partial)

Riffle-riffle slope ____

Rosgen channel type ____
 Channel Evol. Model ____

Stream Quality	Good (G)	Fair (F)	Poor (P)	Score	Possible Pts	%	Condition (G, F, P)
Rosgen C	>155	142-155	<142				
Other	>77.5%	71-77.5%	<71%				
				Former			
				Existing	<u>95</u>	<u>160</u>	<u>59</u> <u>P</u>
				Future**			

NOTE: Rosgen C (<2% slope) based on scoring of all 10 parameters below; Rosgen E may exclude #2, 3, and 7 below; Rosgen A/B may exclude #3 and 5 below; other exclusions on a site specific basis.

**Estimated future score based on the following: ☐ In-Stream Habitat, ☐ NCD Stream Restoration, ☐ Bank Stabilization, ☐ Future Canopy/Riparian Vegetation, ☐ Other

Habitat	Condition Category																					
Parameter	Optimal					Suboptimal					Marginal					Poor					Comment	
1. Epifaunal Substrate/ Available Cover ✓	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are <u>not</u> new fall and <u>not</u> transient).					40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).					20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.					Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.						
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
2. Embeddedness ✓	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.					Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.					Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.					Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.						
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
3. Velocity/Depth Regime ✗	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)					Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).					Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).					Dominated by 1 velocity/depth regime (usually slow-deep).						
SCORE	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	

NKSWRF Stream Quality Assessment Data Sheet **(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)**

4. Sediment Deposition ✓	Little or no enlargement of islands or point bars and less than 5% (< 20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
5. Channel Flow Status X	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
6. Channel Alteration ✓	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	
SCORE	20 19 18 (17) 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
7. Frequency of Riffles (or bends) ✓ $\frac{\text{distance}}{\text{width}} = \frac{70}{8} = 8.75$	Occurrence of riffles relatively frequent; ratio distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.	Continuous riffle can be "good" ↓ 15 in reach
SCORE	20 19 18 17 16	15 14 13 (12) 11	10 9 8 7 6	5 4 3 2 1 0	12
8. Bank Stability (score each bank) ✓	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	22 / 10
SCORE (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0	
9. Vegetative Protection (score each bank) ✓	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by <u>native vegetation</u> , but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	(2) 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	(2) 1 0	
10. Riparian Vegetative Zone Width (score each bank) ✓	Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone < 6 meters; little or no riparian vegetation due to human activities.	
SCORE (LB)	Left Bank 10 9	8 7 6	(5) 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0	

Total Score:

95

NOTES/COMMENTS:

North & Center / Sandbars only

3

NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

STREAM NAME: <u>Aiken Fork</u>				LOCATION: <u>Trib of Central Branch, Forest</u>																																																																																																																																																																					
STATION #: <u>5</u> MILE:				BASIN/WATERSHED:																																																																																																																																																																					
LAT.: LONG.:				COUNTY: <u>Boone</u> USGS 7.5 TOPO:																																																																																																																																																																					
DATE: <u>11/3/08</u> TIME: <u>3:15</u>				INVESTIGATORS: <u>Crystal C. Drummond, J. M. Mize</u>																																																																																																																																																																					
TYPE SAMPLE: <input type="checkbox"/> P-CHEM <input type="checkbox"/> Macroinvertebrate <input type="checkbox"/> FISH <input type="checkbox"/> BACT.																																																																																																																																																																									
<input type="checkbox"/> Stream restoration, completion date																																																																																																																																																																									
WEATHER: Now <input type="checkbox"/> Past 24 hours <input type="checkbox"/> <u>Cloudy</u> <input type="checkbox"/> Heavy rain <input type="checkbox"/> <input type="checkbox"/> Steady rain <input type="checkbox"/> <input type="checkbox"/> Intermittent showers <input type="checkbox"/> <input type="checkbox"/> Clear/sunny <input type="checkbox"/>				Has there been a heavy rain in the last 7 days? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Air temperature ____ °C. Inches rainfall in past 24 hours <u>0.5</u> in. <u>75</u> % Cloud Cover																																																																																																																																																																					
P-Chem: Temp (°C)		D.O. (mg/l)		% Saturation		pH (S.U) Cond. <input type="checkbox"/> Grab																																																																																																																																																																			
INSTREAM WATERSHED FEATURES: Stream Width (riffle, bankfull) ____ ft Range of Pool Depths ____ ft Average Velocity <u>X</u> ft/s Est. Reach Length ____ ft* *Scoring is based on entire restoration reach; not limited to 100 m segment.				LOCAL WATERSHED FEATURES: Predominant Surrounding Land Use: <input type="checkbox"/> Surface Mining <input type="checkbox"/> Construction <input checked="" type="checkbox"/> Forest/Silviculture <input checked="" type="checkbox"/> Lawn <input checked="" type="checkbox"/> Commercial <input type="checkbox"/> Pasture/Grazing <input checked="" type="checkbox"/> Park <input type="checkbox"/> Industrial <input type="checkbox"/> Hay <input type="checkbox"/> Land Disposal / Dumps <input type="checkbox"/> Row Crops <input checked="" type="checkbox"/> Urban Runoff/Storm Sewers																																																																																																																																																																					
Hydraulic Structures: <input type="checkbox"/> Dams <input checked="" type="checkbox"/> Bridge Abutments <input type="checkbox"/> Island <input type="checkbox"/> Waterfalls <input type="checkbox"/> Other				Stream Flow: <input checked="" type="checkbox"/> Dry <input type="checkbox"/> Pooled <input type="checkbox"/> Low <input type="checkbox"/> Normal <input type="checkbox"/> High <input type="checkbox"/> Very Rapid or Torrential																																																																																																																																																																					
Riparian Vegetation: Dom. Tree/Shrub Taxa Dominate Type <u>Maple / oak</u> <input checked="" type="checkbox"/> Trees <input checked="" type="checkbox"/> Shrubs <u>not much</u> <input type="checkbox"/> Grasses <input type="checkbox"/> Herbaceous <u>hardly any grass</u> Number of strata ____				Canopy Cover: <input type="checkbox"/> Fully Exposed (0-25%) <input type="checkbox"/> Partially Exposed (25-50%) <input checked="" type="checkbox"/> Partially Shaded (50-75%) <input checked="" type="checkbox"/> Fully Shaded (75-100%)		Channel Alterations: <input type="checkbox"/> Dredging <input type="checkbox"/> Channelization (Full Partial) Riffle-riffle slope ____ Rosgen channel type ____ Channel Evol. Model ____																																																																																																																																																																			
Stream Quality Rosgen C <u>Good (G)</u> Other <u>Fair (F)</u>				<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Score</th> <th>Possible Pts</th> <th>%</th> <th>Condition (G, F, P)</th> </tr> </thead> <tbody> <tr> <td>Former</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Existing</td> <td><u>88</u></td> <td><u>100</u></td> <td><u>88</u></td> <td><u>G</u></td> </tr> <tr> <td>Future**</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					Score	Possible Pts	%	Condition (G, F, P)	Former					Existing	<u>88</u>	<u>100</u>	<u>88</u>	<u>G</u>	Future**																																																																																																																																																		
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NOTE: Rosgen C (<2% slope) based on scoring of all 10 parameters below; Rosgen E may exclude #2, 3, and 7 below; Rosgen A/B may exclude #3 and 5 below; other exclusions on a site specific basis.				**Estimated future score based on the following: <input type="checkbox"/> In-Stream Habitat, <input type="checkbox"/> NCD Stream Restoration, <input type="checkbox"/> Bank Stabilization, <input type="checkbox"/> Future Canopy/Riparian Vegetation, <input type="checkbox"/> Other																																																																																																																																																																					
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NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

4. Sediment Deposition ✓	Little or no enlargement of islands or point bars and less than 5% (< 20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	Soil Bedded Stream
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
5. Channel Flow Status X	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
6. Channel Alteration ✓	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
7. Frequency of Riffles (or bends) ✗	Occurrence of riffles relatively frequent; ratio distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.	continuous riffle can be "good"
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
8. Bank Stability (score each bank) ✓	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	Frizbee Golf Trail crosses
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	
9. Vegetative Protection (score each bank) ✓	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	
10. Riparian Vegetative Zone Width (score each bank) ✓	Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone < 6 meters; little or no riparian vegetation due to human activities.	Golf Course
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	

Total Score:

82

NOTES/COMMENTS:

4

56p.

4

NKSWRF Stream Quality Assessment Data Sheet
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4. Sediment Deposition ✓	Little or no enlargement of islands or point bars and less than 5% (< 20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	
SCORE	20 19 18 (17) 16	15 14 13 12 (11)	10 9 8 7 6	5 4 3 2 1 0	
5. Channel Flow Status X	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
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SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
7. Frequency of Riffles (or bends) X	Occurrence of riffles relatively frequent; ratio distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.	Continuous riffles can be "good"
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
8. Bank Stability (score each bank) ✓	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 (4) 3	2 (1) 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 (4) 3	2 1 0	
9. Vegetative Protection (score each bank) ✓	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.	
SCORE (LB)	Left Bank 10 9	8 7 6	(5) 4 3	(2) 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0	
10. Riparian Vegetative Zone Width (score each bank) ✓	Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone < 6 meters; little or no riparian vegetation due to human activities.	mowed to stream
SCORE (LB)	Left Bank 10 9	8 (7) (6)	(5) 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	(5) 4 3	2 1 0	

Total Score:

55

NOTES/COMMENTS:

5

NKSWRF Stream Quality Assessment Data Sheet
(Modified from KDOW High Gradient Stream Habitat Assessment Data Sheet)

STREAM NAME: <u>Atlan Park South Branch</u>		LOCATION: <u>South Branch Forested</u>															
STATION #: <u>5</u> MILE:		BASIN/WATERSHED:															
LAT.: LONG.:		COUNTY: <u>Poore</u> USGS 7.5 TOPO:															
DATE: <u>11/13/00</u> TIME: <u>11:25 am</u>		INVESTIGATORS: <u>Crystal C., Dianna W., JTM, Mark L.</u>															
TYPE SAMPLE: <input type="checkbox"/> P-CHEM <input type="checkbox"/> Macroinvertebrate <input type="checkbox"/> FISH <input type="checkbox"/> BACT.																	
<input type="checkbox"/> Stream restoration, completion date																	
WEATHER:		Has there been a heavy rain in the last 7 days?															
Now <input type="checkbox"/> Heavy rain Past 24 hours <input type="checkbox"/> Steady rain <input type="checkbox"/> Intermittent showers <u>raining</u> <input type="checkbox"/> Clear/sunny		<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Air temperature _____ °C. Inches rainfall in past 24 hours <u>2.4</u> in. <u>100</u> % Cloud Cover															
P-Chem: Temp (°C)	D.O. (mg/l)	% Saturation	pH (S.U) Cond. <input type="checkbox"/> Grab														
INSTREAM WATERSHED FEATURES:		LOCAL WATERSHED FEATURES:															
Stream Width (riffle, bankfull) _____ ft Range of Pool Depths <u>6"</u> ft Average Velocity _____ ft/s Est. Reach Length _____ ft* *Scoring is based on entire restoration reach; not limited to 100 m segment.		Predominant Surrounding Land Use: <input type="checkbox"/> Surface Mining <input type="checkbox"/> Construction <input checked="" type="checkbox"/> Forest/Silviculture <input checked="" type="checkbox"/> Lawn <input checked="" type="checkbox"/> Commercial <input type="checkbox"/> Pasture/Grazing <input checked="" type="checkbox"/> Park <input type="checkbox"/> Industrial <input type="checkbox"/> Hay <input type="checkbox"/> Land Disposal / Dumps <input type="checkbox"/> Row Crops <input checked="" type="checkbox"/> Urban Runoff/Storm Sewers															
Hydraulic Structures: <input type="checkbox"/> Dams <input checked="" type="checkbox"/> Bridge Abutments <input type="checkbox"/> Island <input type="checkbox"/> Waterfalls <input type="checkbox"/> Other		Stream Flow: <input type="checkbox"/> Dry <input type="checkbox"/> Pooled <input checked="" type="checkbox"/> Low <input type="checkbox"/> Normal <input type="checkbox"/> High <input type="checkbox"/> Very Rapid or Torrential															
Riparian Vegetation: Dominate Type <u>Maple / Hickory</u> <input checked="" type="checkbox"/> Trees <input checked="" type="checkbox"/> Shrubs <u>White Snake Rd</u> <input checked="" type="checkbox"/> Grasses <u>late flowering shrubs</u> Number of strata _____		Canopy Cover: <input type="checkbox"/> Fully Exposed (0-25%) <input type="checkbox"/> Partially Exposed (25-50%) <input type="checkbox"/> Partially Shaded (50-75%) <input checked="" type="checkbox"/> Fully Shaded (75-100%)															
Channel Alterations: <input type="checkbox"/> Dredging <input type="checkbox"/> Channelization (<input type="checkbox"/> Full <input type="checkbox"/> Partial)		Riffle-riffle slope _____ Rosgen channel type _____ Channel Evol. Model _____															
Stream Quality Rosgen C <u>>155</u> Other <u>>77.5%</u>		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Good (G)</th> <th>Fair (F)</th> <th>Poor (P)</th> <th>Score</th> <th>Possible Pts</th> <th>%</th> <th>Condition (G, F, P)</th> </tr> </thead> <tbody> <tr> <td>155</td> <td>142-155</td> <td><142</td> <td>96</td> <td>140</td> <td>61</td> <td>P</td> </tr> </tbody> </table>		Good (G)	Fair (F)	Poor (P)	Score	Possible Pts	%	Condition (G, F, P)	155	142-155	<142	96	140	61	P
Good (G)	Fair (F)	Poor (P)	Score	Possible Pts	%	Condition (G, F, P)											
155	142-155	<142	96	140	61	P											
NOTE: Rosgen C (<2% slope) based on scoring of all 10 parameters below; Rosgen E may exclude #2, 3, and 7 below; Rosgen A/B may exclude #3 and 5 below; other exclusions on a site specific basis.		**Estimated future score based on the following: <input type="checkbox"/> In-Stream Habitat, <input type="checkbox"/> NCD Stream Restoration, <input type="checkbox"/> Bank Stabilization, <input type="checkbox"/> Future Canopy/Riparian Vegetation, <input type="checkbox"/> Other															
Habitat		Condition Category															
Parameter	Optimal	Suboptimal	Marginal	Poor	Comment												
1. Epifaunal Substrate/Available Cover <u>✓</u> Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.														
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0													
2. Embeddedness <u>✓</u> Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.														
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0													
3. Velocity/Depth Regime <u>✗</u> All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/depth regime (usually slow-deep).														
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0													

5

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4. Sediment Deposition ✓	Little or no enlargement of islands or point bars and less than 5% (< 20% for low-gradient streams) of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% (20-50% for low-gradient) of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% (50-80% for low-gradient) of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% (80% for low-gradient) of the bottom changing frequently; pools almost absent due to substantial sediment deposition.	
SCORE	20 19 18 17 16	(15) 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
5. Channel Flow Status X	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or < 25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
6. Channel Alteration ✓	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr.) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	
SCORE	20 19 18 17 (16)	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
7. Frequency of Riffles (or bends) X	Occurrence of riffles relatively frequent; ratio distance between riffles divided by width of the stream < 7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of > 25.	Continuous riffle can be "good"
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0	
8. Bank Stability (score each bank) ✓	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. < 5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight section and bends; obvious bank sloughing; 60-100% of bank has erosional scars.	
SCORE (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0	
9. Vegetative Protection (score each bank) ✓	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.	
SCORE (LB)	Left Bank 10 9	(8) 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0	
10. Riparian Vegetative Zone Width (score each bank) ✓	Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone < 6 meters; little or no riparian vegetation due to human activities.	
SCORE (LB)	Left Bank 10 (9)	8 7 6	5 4 3	2 1 0	
SCORE (RB)	Right Bank 10 9	8 7 (6)	5 4 3	2 1 0	

Total Score:

86

NOTES/COMMENTS:

APPENDIX C – EROSION CONTROL PRACTICES (ECP)

PURPOSE - The purpose of these ECPs is to minimize the release of soil / sediment to streams from disturbed areas. Emphasis is on erosion prevention rather than trying to capture released sediments.

PERMITS & NOTIFICATIONS – In addition to obtaining all necessary permits, KPDES will be given 48 hours notice and Sanitation District 1 will be given 72 hours notice (for projects within SD1 jurisdiction) prior to soil disturbance activity exceeding one acre. (See Plan for permitting requirements.)

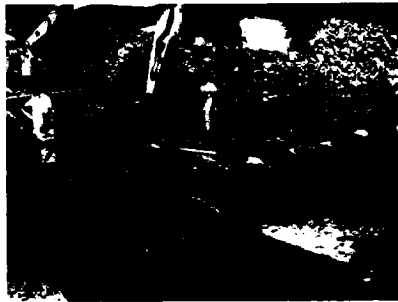
GENERAL PRACTICES – One of the primary purposes of stream and wetland restoration is **long-term** mitigation of erosion and sedimentation, through restoring floodplain connectivity, bank and channel stabilization, re-forestation of riparian buffers, etc. The following general practices will be implemented during and after soil disturbance activities to minimize **short term** erosion:

1. Existing vegetation and root structures will be **preserved and protected** to the extent practicable.
2. Construction activities will be **scheduled** to avoid high stream levels, excessively wet soils, anticipated rain, extended periods of unprotected soils, and unfavorable seasons for rapid vegetative cover establishment (winter). Pump-around and/or sediment collection practices will be implemented as necessary.
3. During exposed soil conditions, practices will be **inspected** at least weekly and after ½-inch or more of rain. Any necessary repairs will be implemented expeditiously to ensure adequate performance.
4. Using an **adaptive management** approach, particular practices may be modified in the field at the discretion of the project engineer, if consistent with the purpose of these ECPs.
5. If soil disturbance activities are temporarily ceased (21 days or more), or if heavy rain is anticipated during construction, **temporary measures** will be implemented such as temporary straw cover or erosion control blanket.
6. Final soil protection practices will be implemented **expeditiously**, usually within a day or two of final grading (but not exceeding 14 days after final grading). Prior to final practices, soil will be “fluffed” to promote moisture retention and plant success.

BMPs – The following is a presentation of **best management practices** that are routinely implemented at stream and wetland restoration projects for short- and long-term erosion protection. Additional BMPs may be implemented at the discretion of the project engineer.



Where practicable, bare vertical banks are **sloped and vegetated** to mitigate bank erosion. The target slope is generally 3:1 or less, unless a steeper slope is necessitated by site conditions. A **stone toe** may be placed at the base of the slope to provide short- and long-term protection against bank undermining. Alternative bank and toe protections include **rock vanes, root wads and coir logs**.



Disturbed soils below the ordinary high water mark (bankfull elevation) will be protected with durable, 100 percent biodegradable **erosion control blankets (ECBs)**. High stress areas such as outside bends will be protected with five-year coir blanket (RoLanka BioD-Mat 90 or equivalent). The lower edge of coir ECB may be keyed into the soil ("**soil wrap**") to prevent washout. At the discretion of the project engineer, lower stress areas such as floodplains and inside bends may be protected with 12-month jute-reinforced straw blanket.



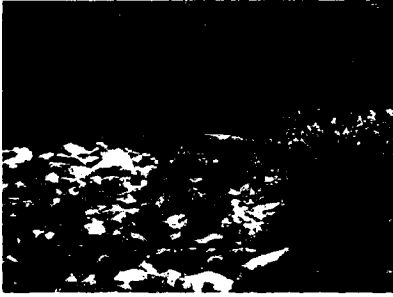
Disturbed soils above the bankfull elevation will be **covered with straw** to facilitate plant establishment and protect against raindrop impact erosion. Straw will be applied by hand-spreading or with a straw blower. At the discretion of the restoration ecologist, the straw may be tacked with netting or bonding agent if necessary due to wind or steep slopes.



Prior to placement of ECBs and straw, bare soil will be seeded with a season-appropriate **temporary cover crop** (e.g., annual wheat, rye, or oats at 3 pounds per 1000 sq ft) to provide short-term erosion protection. A site-appropriate mix of **native herbaceous, shrub, and tree seeds**, plus fertilizer if necessary, will also be seeded to provide long-term erosion protection. Light disking may be used before and/or after seeding at the discretion of the restoration ecologist.



Rock checks or constructed riffles are installed in incised channels to raise the channel elevation, provide roughness and stability, and to capture sediments. If practical, they are constructed from natural flagstone rather than blasted rock, and are keyed into the banks to prevent flanking. The maximum spacing is 5 channel widths for channel slopes less than 2 percent, decreasing to one channel width for 8 percent slopes. On channels greater than 2 percent, collected sediments may be left in-place to mimic natural step-pools.



Concentrated flow channels, for example from constructed wetlands, are stabilized using **rock-lined spillways**, underlain with non-woven filter fabric. Rock joints eventually silt-in and vegetation becomes established, further enhancing stability and ecological benefit.



Limited-traffic vehicle crossings on small tributaries will be stabilized by constructing **rock fords**, and may be underlain by non-woven filter fabric, in accordance with NRCS standards such as maximum 5:1 approach slopes.

APPENDIX D – RIPARIAN RESTORATION PLAN

PURPOSE – The purpose of this plan is to document procedures for the restoration and enhancement of native plant communities within the riparian buffer. The target native plant communities will exhibit a diversity of native wildflowers and grasses (meadows) and trees and shrubs (forest restoration) with high ecological value.

INVASIVE VEGETATION ERADICATION & CONTROL - Within the forested riparian buffer, the most common non-native invasive plants for targeted eradication include bush honeysuckle and multiflora rose. Within the non-forested riparian buffer, fescue and other cool-season grasses are the predominant invasive plants. Additional invasives will be controlled if during maintenance and monitoring they are found to threaten enhancement and restoration efforts.

The method of eradication and control is as follows: Physically remove, or cut and stump treat woody invasives such as bush honeysuckle with 20% glyphosate. Mow non-woody invasives such as fescue. Treat mowed non-woody vegetation and low growing woody vegetation with 2% glyphosate, one or more times as necessary to achieve control. Spot treat as necessary during the five-year maintenance and monitoring period.

CANDIDATE SPECIES FOR RE-FORESTATION (NOT ALL INCLUSIVE) - Candidate species of native plants short-listed for low organic, poor structure, clayey soil conditions are provided in Table 3. Species will be planted or seeded according to the site conditions (e.g., relative soil wetness, sun/shade, soil quality) and availability. No species will comprise more than 25 percent of the total planting.

Table 3 - Planting Palette

Common Name	Species	Indicator Status
Tree		
red maple	<i>Acer rubrum</i>	FAC
silver maple	<i>Acer saccharinum</i>	FACW
hackberry	<i>Celtis occidentalis</i>	FACU
redbud	<i>Cercis canadensis</i>	FACU-
persimmon	<i>Diospyros virginiana</i>	FAC-
spicebush	<i>Lindera benzoin</i>	FACW-
sycamore	<i>Platanus occidentalis</i>	FACW-
swamp white oak	<i>Quercus bicolor</i>	FACW+
shingle oak	<i>Quercus imbricaria</i>	FAC
bur oak	<i>Quercus macrocarpa</i>	FAC-
pin oak	<i>Quercus palustris</i>	FACW

Common Name	Species	Indicator Status
Shumard oak	<i>Quercus shumardii</i>	FAC+
Wildflowers		
New England aster	<i>Aster novae-angliae</i>	FAC
partridge pea	<i>Chamaecrista fasciculata</i>	FACU
boneset	<i>Eupatorium perfoliatum</i>	FACW+
oxeye sunflower	<i>Heliopsis helianthoides</i>	UPL
white snakeroot	<i>Ageratina altissima</i>	UPL
gray-headed coneflower	<i>Ratibida pinnata</i>	UPL
black-eyed Susan	<i>Rudbeckia hirta</i>	FACU-
cut-leaf coneflower	<i>Rudbeckia laciniata</i>	FACW
browneyed Susan	<i>Rudbeckia triloba</i>	FACU
Grasses		
Virginia wildrye	<i>Elymus virginicus</i>	FACW-
deertongue witchgrass	<i>Panicum clandestinum</i>	UPL
little bluestem	<i>Schizachyrium scoparium</i>	FACU-
indiangrass	<i>Sorghastrum nutans</i>	UPL

PLANTING / SEEDING PLAN BY ZONE - Table 4 provides the planting plan by zone.

Table 4 - Planting Plan by Zone

Planting Zone	Plant Type	Plant Form	Planting Density
5.5-Acre Bare Soil Area Reforestation	Trees and Shrubs	1-gallon containers or bare root seedlings	800 plants/acre (except in managed meadows where trees will be planted in clumps at 40 plants/acre)
	Trees and Shrubs	Seeds	10 lbs/acre
	Native Wildflowers	Seeds	10 lbs/acre
	Native Grasses	Seeds	12 lbs/acre
7-Acre Forest Enhancement	Trees and Shrubs	1-gallon containers	40 plants/acre (as necessary)
	Native Wildflowers	Seeds	5 lbs/acre
	Native Grasses	Seeds	12 lbs/acre